



# sbfoton

SPONSORS:



**Padtec**



## Panel SBFoton ROAD

### - Redes Ópticas Abertas e Desagregadas

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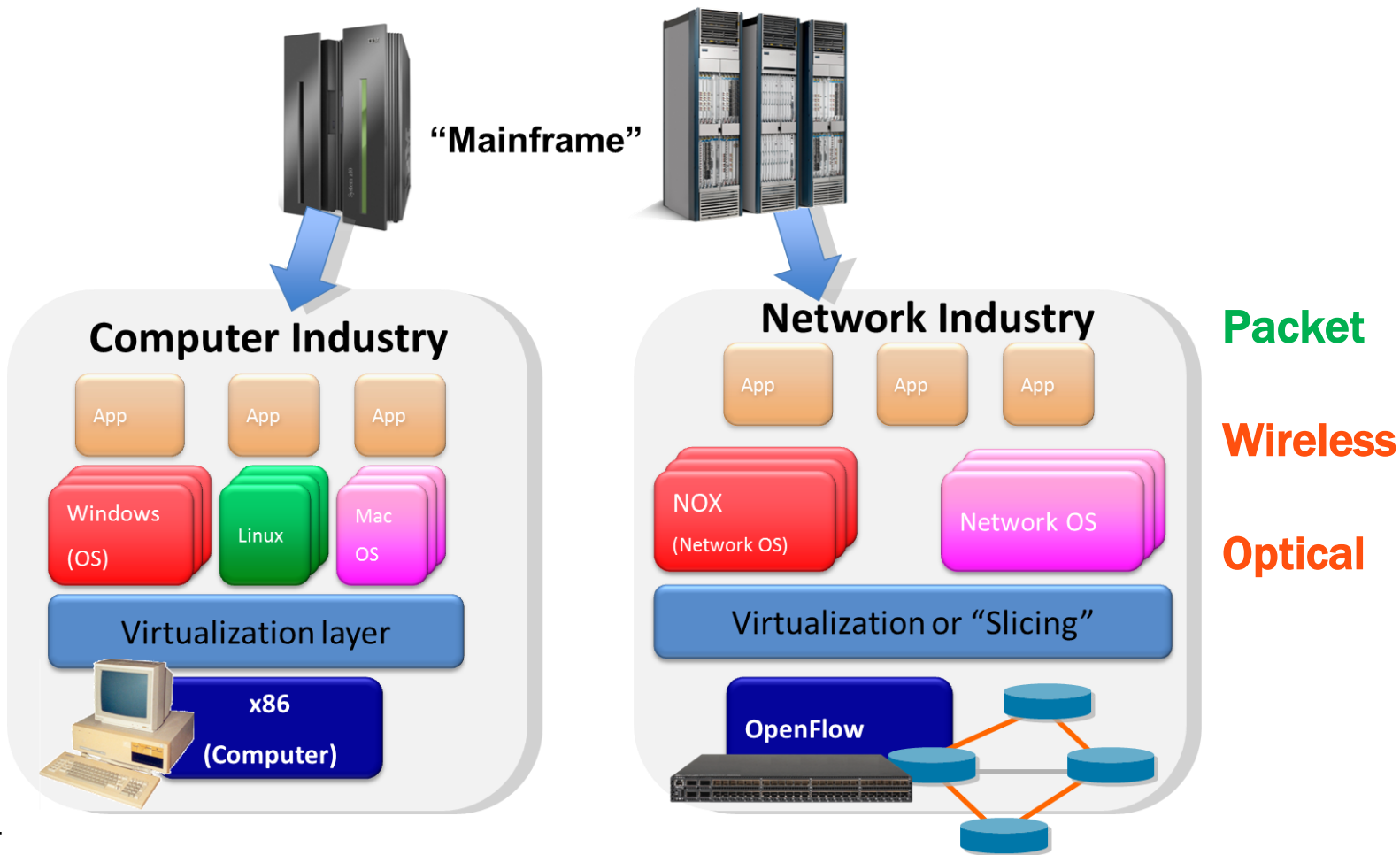
01. Dec 2021, 10:00 – 12:00

<https://intrag.dca.fee.unicamp.br/christian>  
<http://www.dca.fee.unicamp.br/~chesteve/>



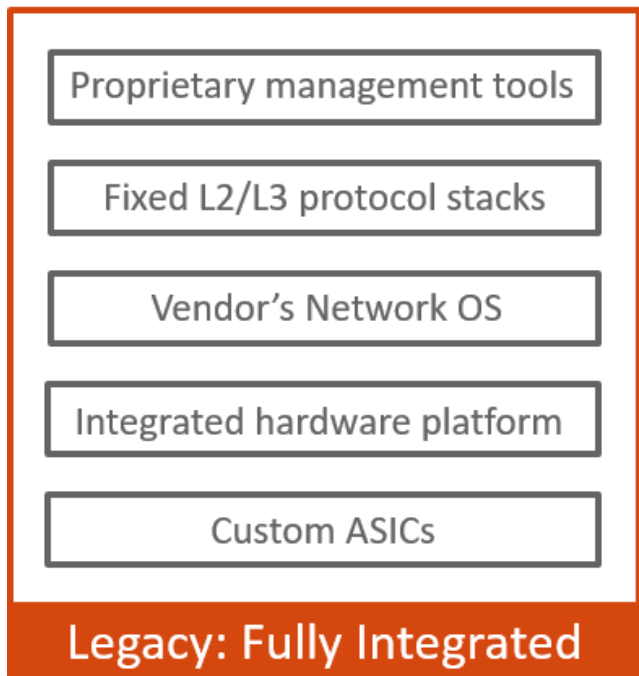


# The Disaggregation Trend (original SDN vision)



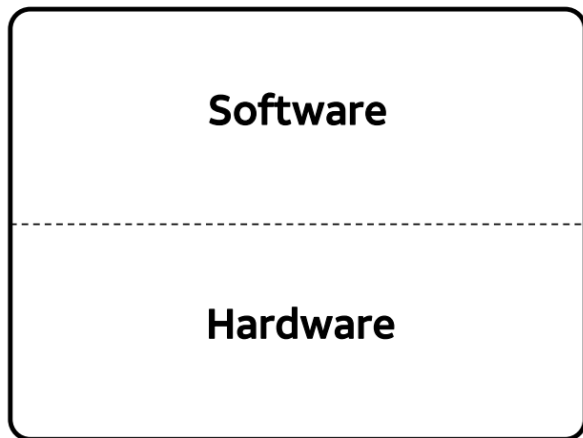


# Dissaggregated Packet Processing Devices





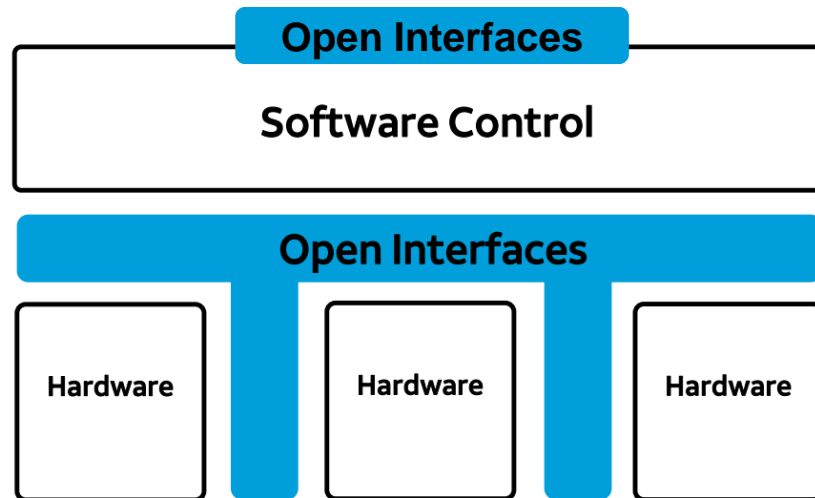
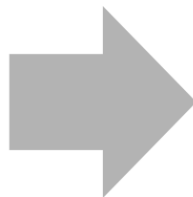
# SDN Disaggregation :: Shift to Open & Flexible



Proprietary

Fixed

Siloed



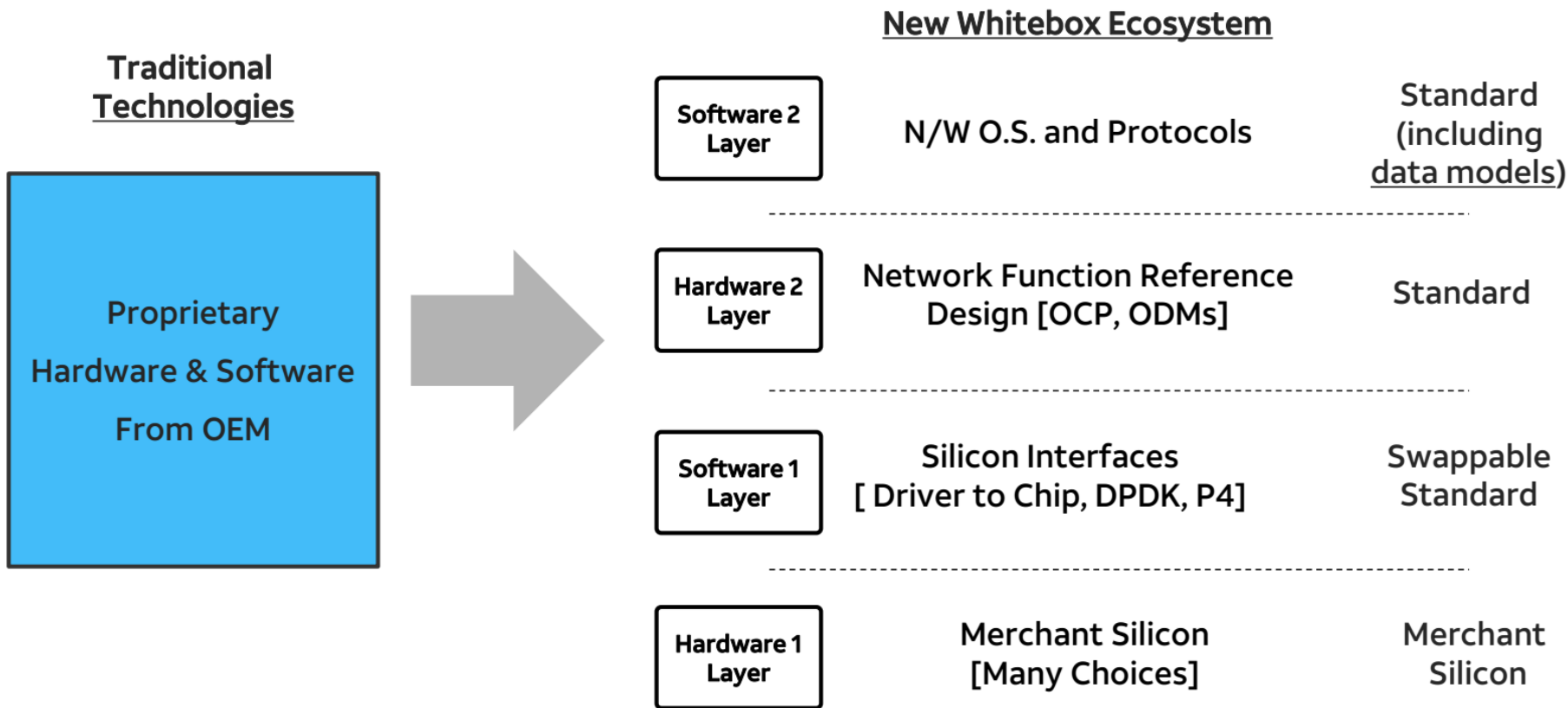
Open - Standard

Flexible

Modular

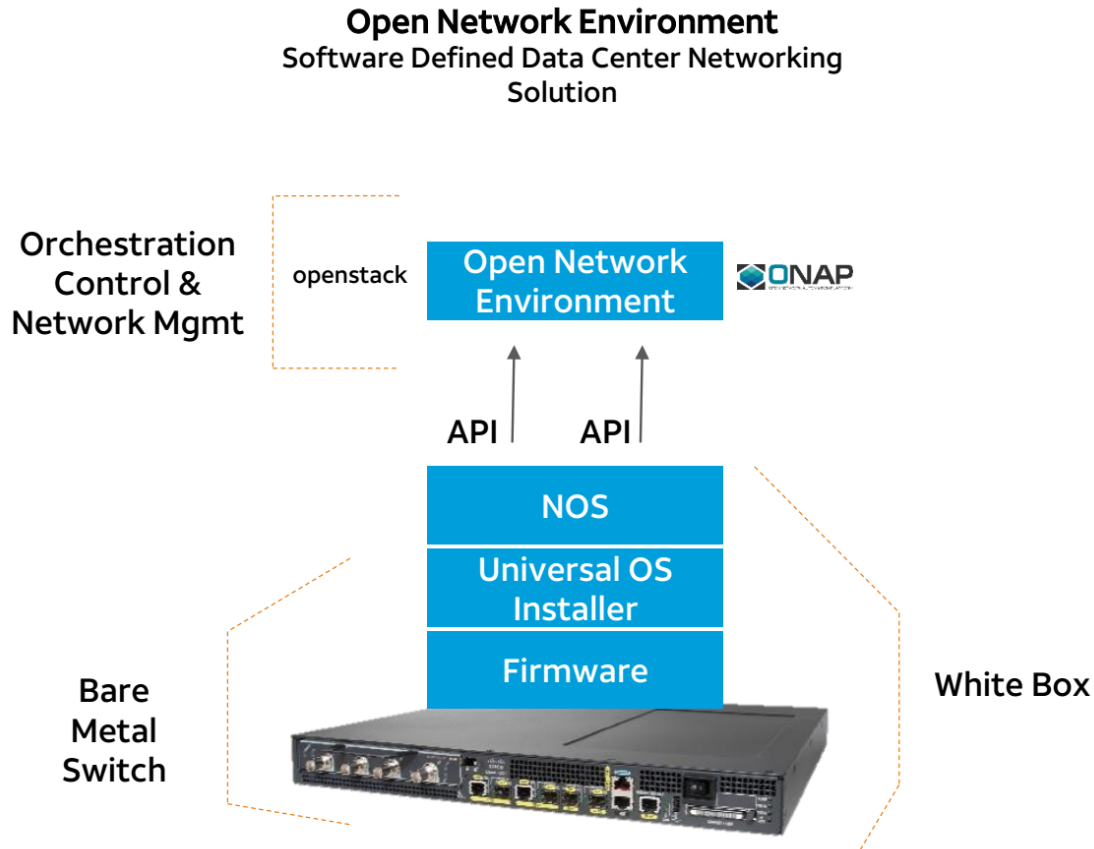


# Whitebox :: Disaggregation of Network Elements



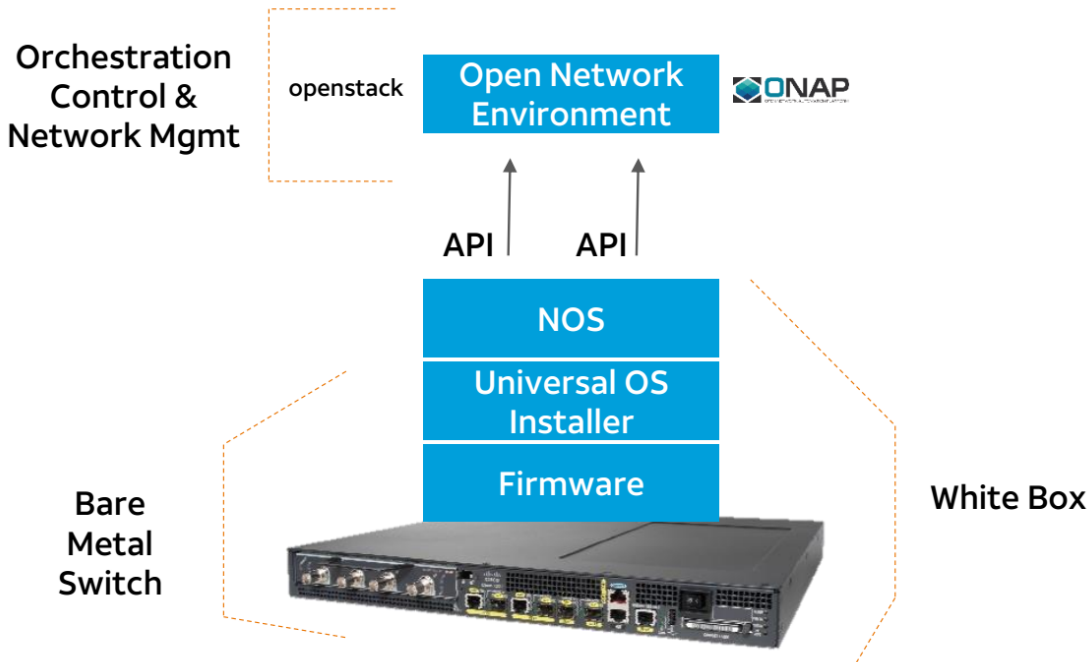
## Benefits

- Not Custom Built
- Open Platform/Interfaces
- Off-the-Shelf Technology
- Multi-Vendor Sourced
- Network ASIC Data Plane



# Whitebox :: Opportunity & Benefits

## Open Network Environment Software Defined Data Center Networking Solution



## Benefits

- Modular with Open Interfaces
- Built on Merchant Silicon
- Lower CAPEX and OPEX for the new solution
- Better visibility and input into silicon roadmap
- Using original design manufacturers (ODMs) for hardware configurations
- A growing, open hardware ecosystem in communities like the Open Compute Project (OCP)



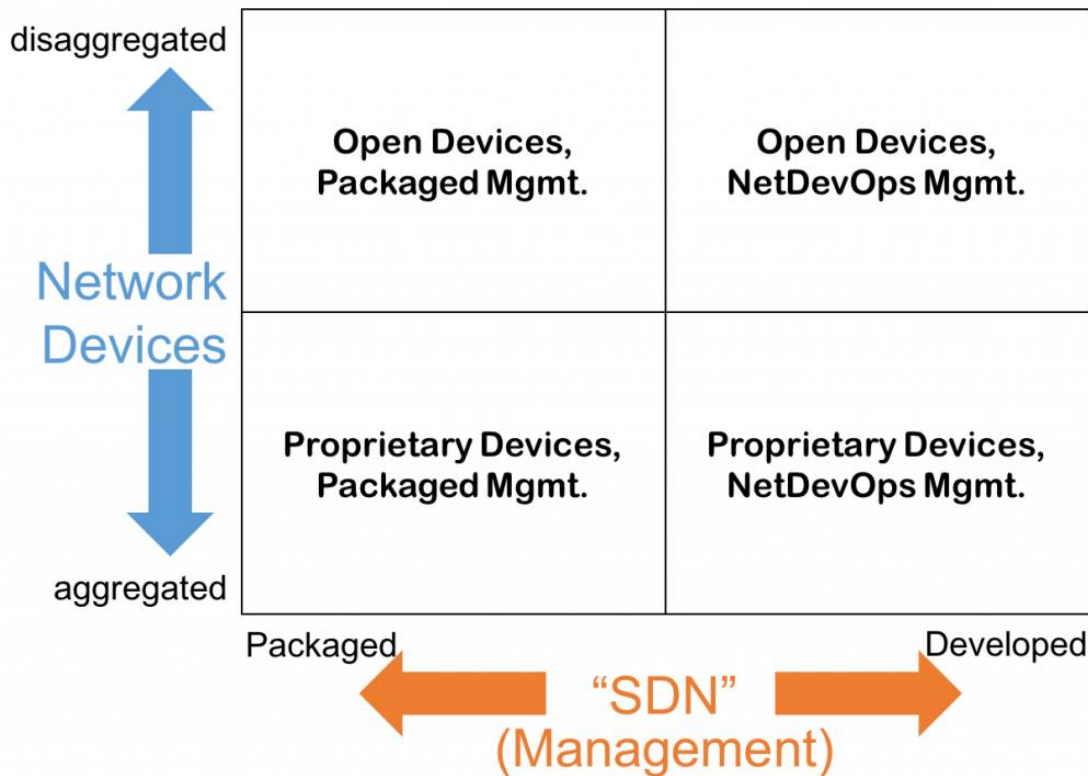
# Software Defined Networking (SDN) : Concepts







# SDN & Disaggregation Quadrants





# Fluid Networking: The HW-SW Continuum

SW

HW

- Containers
- User space
- Kernel space
- Drivers, I/O SDKs
- General-purpose CPU
- HW-accelerated features\*\*
- FPGA
- GPU, TPU,
- Programmable NIC, ASIC
- **Domain Specific Architectures**  
e.g., P4 & PISA

**Flexibility\***  
(programmability + portability)



**Performance\*\*\***

TABLE II  
TECHNICAL CONCEPTS AND THEIR SUPPORT OF FLEXIBILITY IN NETWORKS. (✓: MAIN TARGET)

Category	Aspect (see Sec. III-B)	SDN	NFV	NV
Adapt configuration	Flow Configuration: flow steering	✓	-	-
	Function Configuration: function programming	-	✓	-
Locate functions	Parameter Configuration: change function parameters	-	✓	✓
	Function Placement: distribution, placement, chaining	-	✓	✓
Scale	Resource and Function Scaling: processing and storage capacity, number of functions	✓	✓	✓
	Topology Adaptation: (virtual) network adaptation	-	-	✓

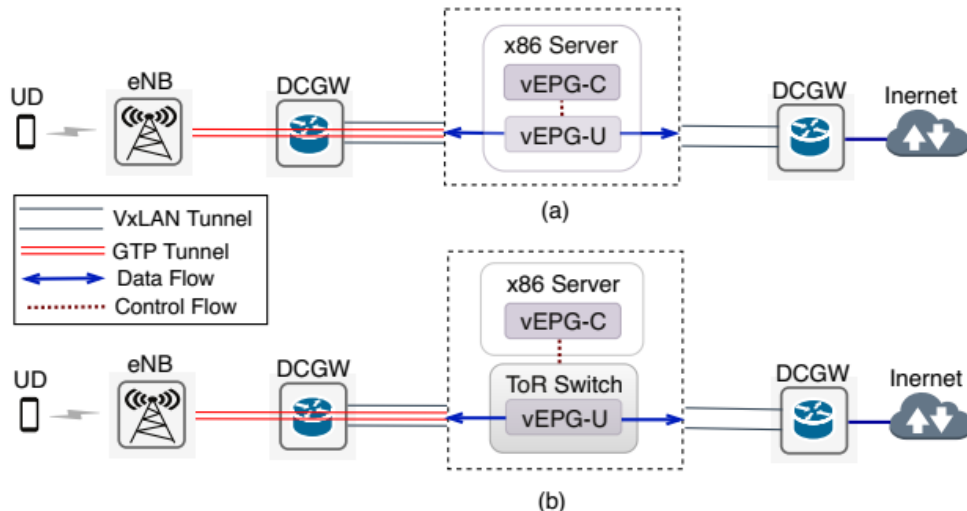
\* M. He et al. **Flexibility in Softwarized Networks: Classifications and Research Challenges**. IEEE Survey & Tutorials, 2019

\*\* Linguaglossa et al. **Survey of Performance Acceleration Techniques for Network Function Virtualization**. Proc. of IEEE, 2019

\*\*\* G. Bianchi. **Back to the Future: Hardware-specialized Cloud Networking**. 2019



# Towards 5G scalable dataplanes



SW  
↓  
HW

Suneet Kumar Singh, Christian Esteve Rothenberg, Gyanesh Patra, Gergely Pongrácz. **Offloading Virtual Evolved Packet Gateway User Plane Functions to a Programmable ASIC.** In 1st ACM CoNEXT Workshop on Emerging in-Network Computing Paradigms (ENCP'19)

Pattam Gyanesh Patra, Fabricio Rodriguez, Juan Sebastian Mejia, Daniel Lazkani Feferman, Levente Csikor, Christian Esteve Rothenberg, Gergely Pongrácz. **Towards a Sweet Spot of Dataplane Programmability, Portability and Performance: On the Scalability of Multi-Architecture P4 Pipelines.** In IEEE JSAC, 2018

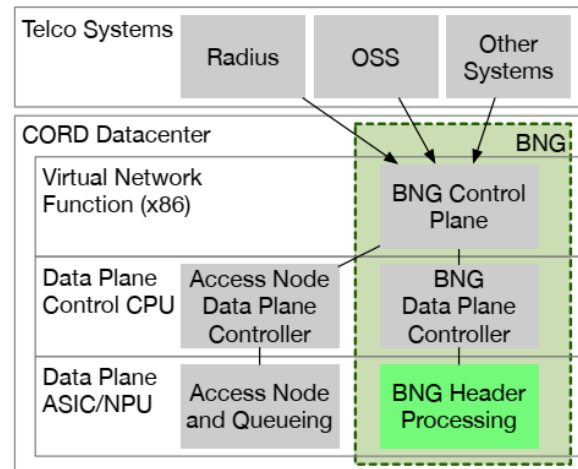
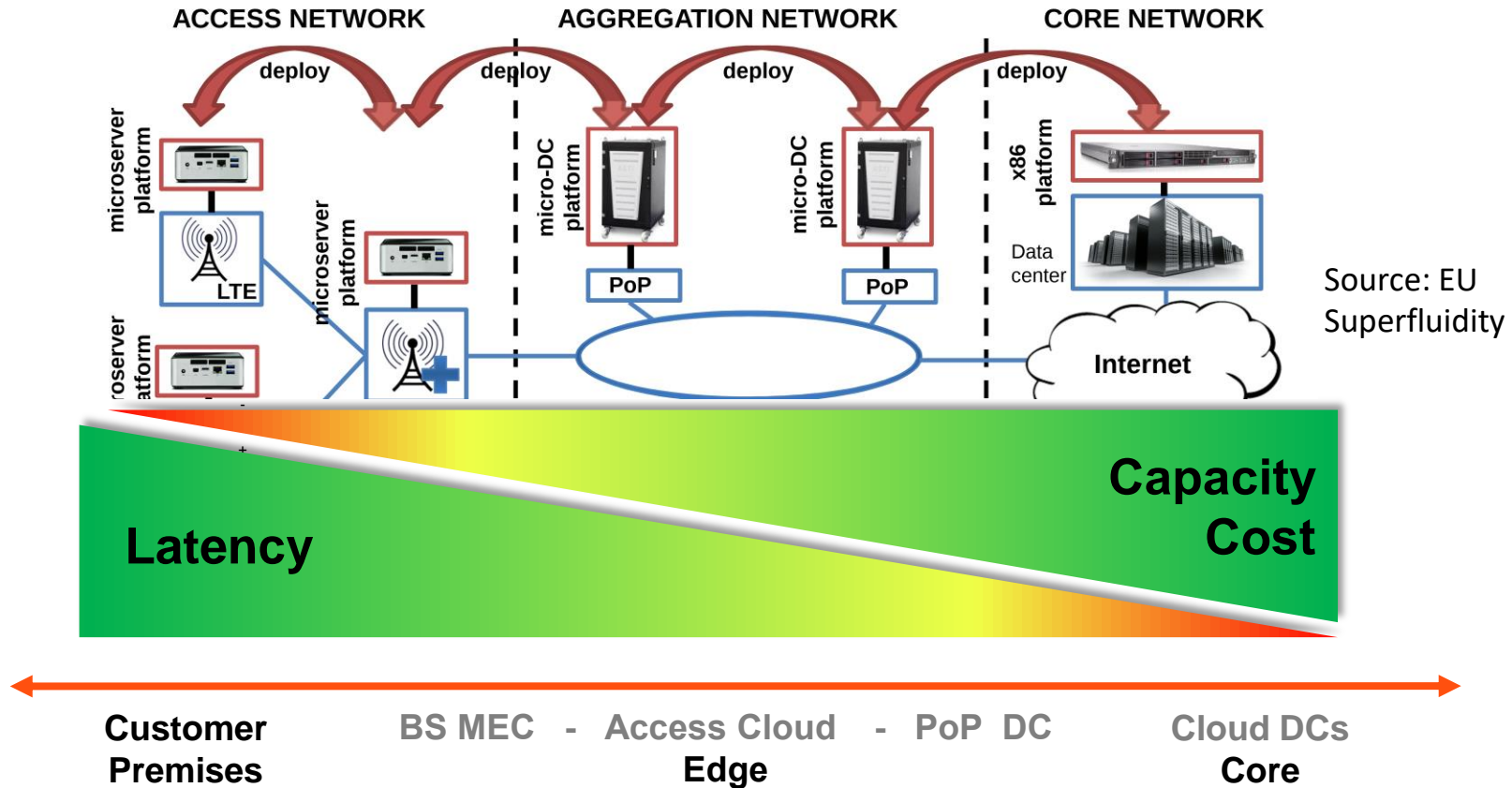


Fig. 3: CORD-Service Edge component overview.



# Fluid Networking: Decoupling functionality / location





# Network Disaggregation :: New Ownership Options

## Option 1:

Service provider can, essentially own or control the integration, delivery and support for the entire solution

## Option 2:

Service provider can control the design and specification of hardware and software modules and use third party integrators for manufacturing, break-fix, integration, and maintenance services.

## Option 3:

Service provider to specify exactly what elements are to be used and what features are desired, and buy the complete solution from a single entity, specifying which elements and features you want.



# After disaggregation :: New Ownership Options

Technical Expertise + Single Throat to Choke

**Actors** with sufficient  
SW Eng. + Network Eng.  
& in-house DevOps (NoOps?)



Microsoft



NTT

Goglee



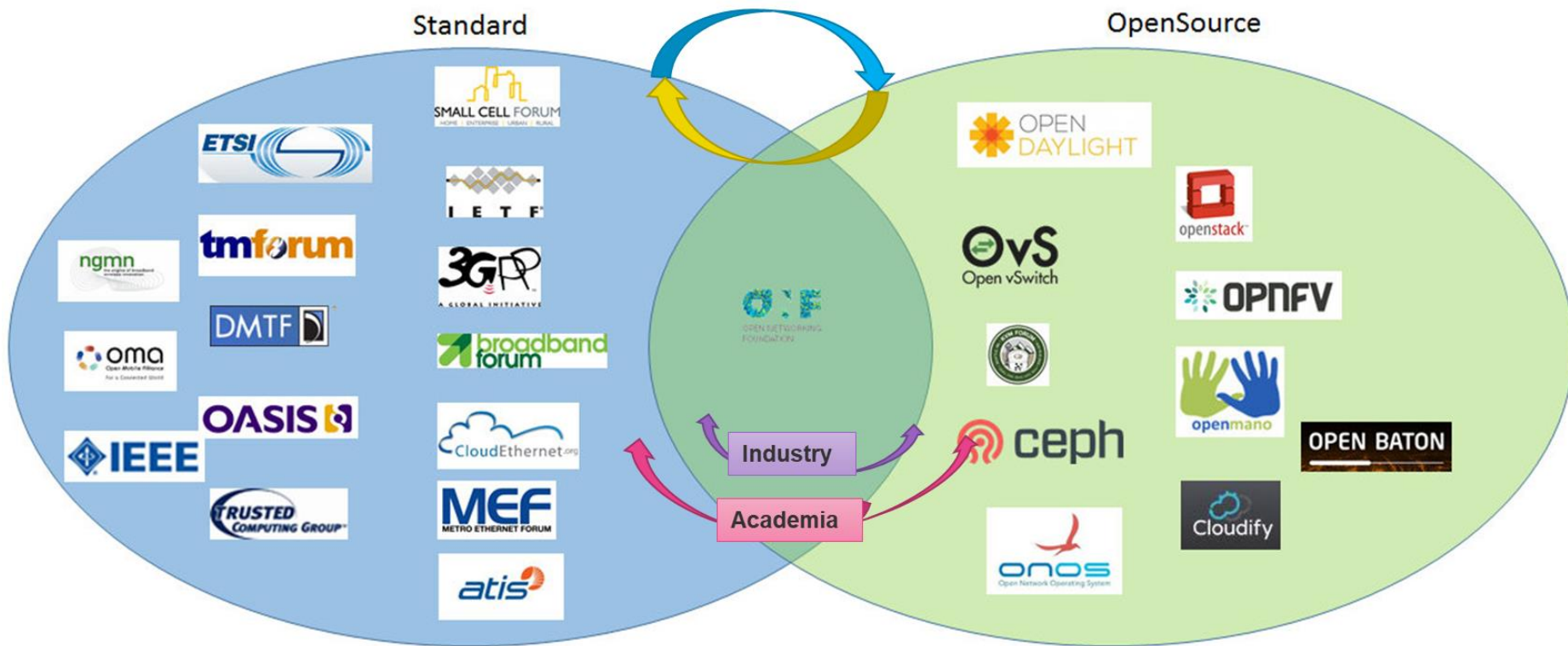
## Enablers

- Open Models
- Intent-based (languages + APIs)
- Design + Run-time (NS)DKs
- ML/AI assistance
- Automation of Test + Benchmarking (pre-deployment + day0 & day-2 ops)

The **long tail** of players

(e.g. smaller SPs, ISPs, enterprises, campus, governments, etc.)

# Disaggregation & Opportunities for Academia





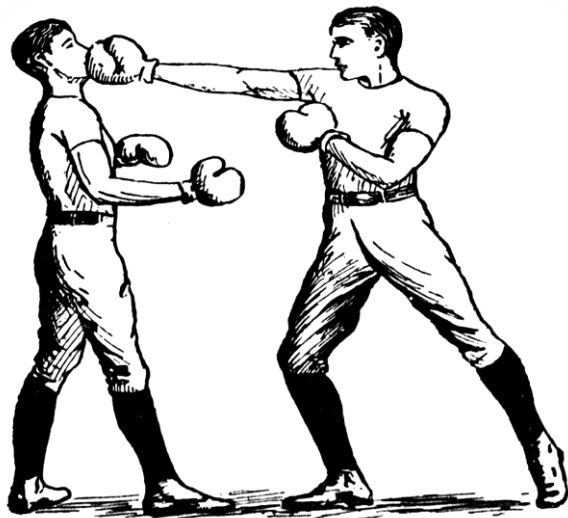
# Disaggregation & Opportunities for Academia

- Every **open API** / interface is an opportunity
- Every **open SW** component is an opportunity
- **Open data** is an opportunity
  
- Fill **industry gaps** with student skills and time availability
- Work on **real problems**
- Validate research ideas under **real conditions**
- **True impact** results





# Network Softwarization / Disaggregation (i.e. SDN + NFV + IBN + xyz)



## From:

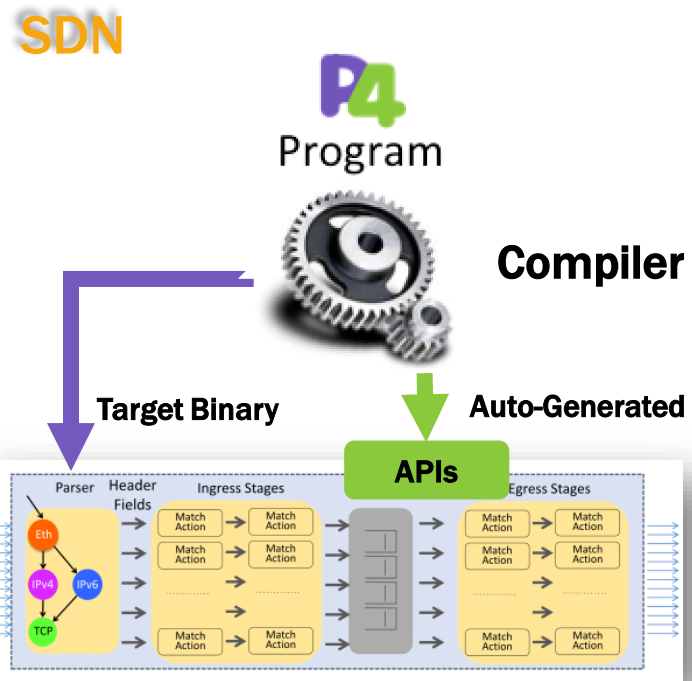
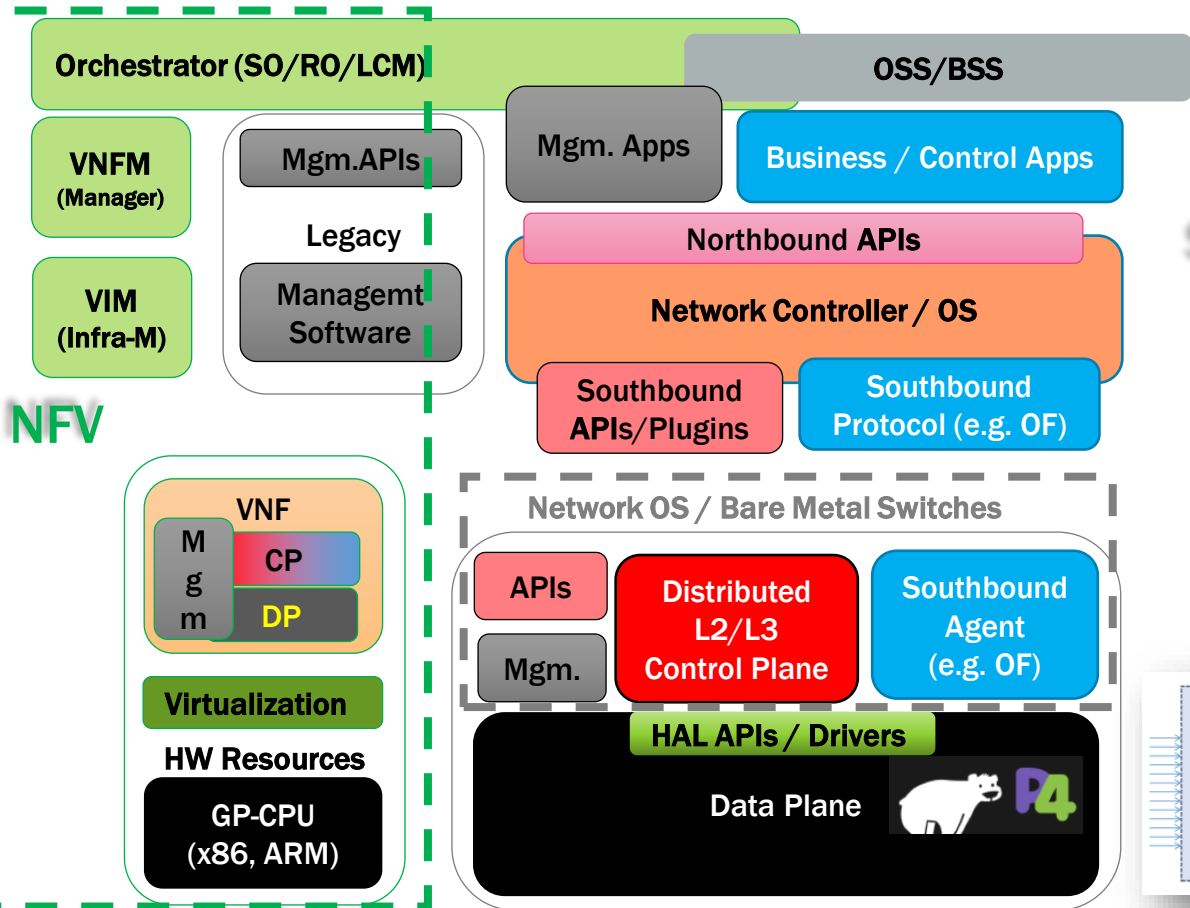
- CLIs & Manual labour
- Closed Source
- Vendor Lead
- Classic Network Appliances (HW)

## To:

- APIs & Automation
- Open Source
- Customer Lead
- Virtual Network Functions (NFV/SW)

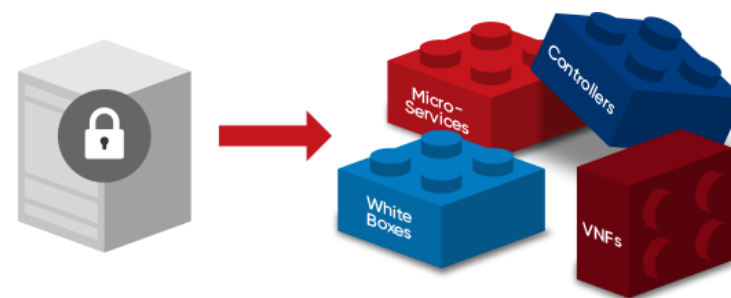


# How :: Models & Approaches to Network Programmability

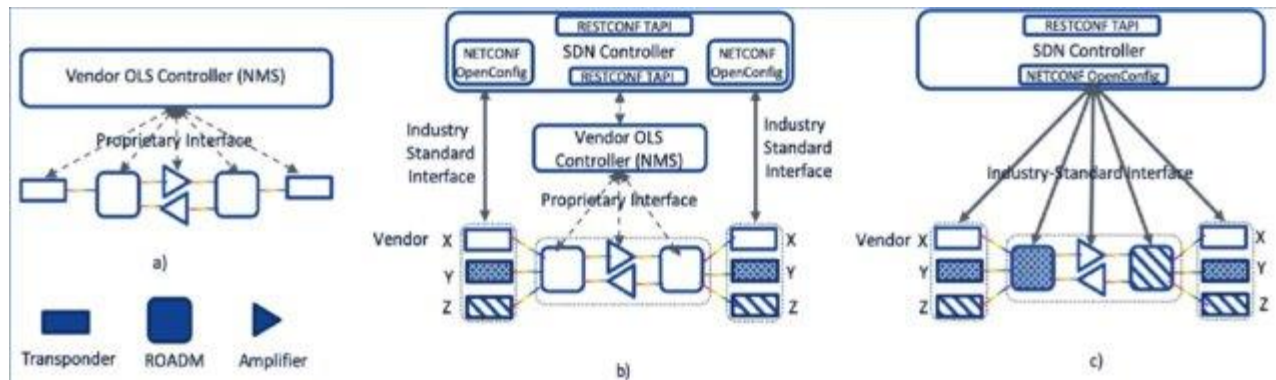


# Conclusions

- ❑ Disaggregation of packet networks: **Reality**
- ❑ Disaggregation of wireless networks: **Ongoing**
  - 5G split architecture, ONF, O-RAN, TIP OpenRAN, etc.
- ❑ Disaggregation of optical networks: **Ongoing**



- ONF
- TIP
- OpenConfig
- OpenROADM



a) Current Optical Network; b) Partially Disaggregated Optical Network; c) Fully Disaggregated Optical Network  
Source: OFC 2020 "Demonstration of Alarm Correlation in Partially Disaggregated Optical Networks"